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DIVERSITY IN PRODUCT FAMILIARITY ACROSS YOUNGER AND OLDER ADULTS

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ABSTRACT

This paper reports on the findings of a completed experiment examining levels of familiarity in younger and older adults. Research has shown that older adults use products less intuitively than younger adults, and that familiarity is an essential element of intuitive interaction. This finding influenced the decision to focus on familiarity and to investigate why older adults use products less intuitively than younger adults. By identifying and understanding the differences in familiarity, it is hypothesised that designers will be able to design more usable products for older adults. An empirical study was conducted, investigating the differences in familiarity between younger and older adults with contemporary products. Younger adults demonstrate significantly higher levels of familiarity compared to older adults, and the three groups of older adults demonstrated no significant differences between them. The implications of this finding is discussed.

Keywords: Familiarity, Intuitive interaction, Older Adults

INTRODUCTION

Global demographic changes are resulting in higher numbers and proportions of older adults than ever before in most countries around the world (Lloyd-Sherlock, 2000). The percentage of Australians 65 and over is expected to increase from the current rate of 13.6% to 16.4% by 2015 (Pink, 2010).

There is also an unprecedented amount of technology encountered in day-to-day living. Increasingly these products are electronic, more complicated, and have more inbuilt functions and services than ever before (Hurtienne & Blessing, 2007; Margolin, 1995). Many older adults have some difficulties using contemporary products. Ageing results in the decline of a variety of capabilities that affect how older adults use products (Gregor, Newell, & Zajicek, 2002).

The combination of an ageing population and an increase in the prevalence of technology, which older adults find difficult to use, unveils an issue which is going to increase in magnitude if left unattended. That issue is a technological world, which has not considered a significant and growing portion of the population.

OLDER ADULTS

Technology has the potential to help older adults live richer and more rewarding lives (Fisk, Rogers, Charness, Czaja, & Sharit, 2009), yet the experience is often one of difficulty (Kang & Yoon, 2008). There is a wide range of benefits to overcoming these difficulties. These include improved social integration, higher levels of independence, and improved health management (Mynatt, Essa, & Rogers, 2000). All of these benefits are likely to lead to a higher standard of living.

Older adults are poorly defined by chronological age, as individual ability varies greatly (Zajicek, 2004). There is also no generally accepted definition of an older adult (Charness, 2008). Some researchers refer to older adults as 65+ (Lundberg & Hakamies-Blomqvist, 2003), while others divided those above 60 into two groups, ‘young old’ (60 – 75), and ‘old old’ (75+) (Fisk et al., 2009). Hawthorn (1998) reports that age-related declines in abilities begin in the early 30's, but the effects only start to become noticeable around the age of 45.

Age related declines affect many cognitive, physical and sensory capabilities (Gregor et al., 2002). These declines can affect vision, speech, hearing, memory and learning, psychomotor abilities, attention, automated responses, intelligence, and fine motor control (Hawthorn, 2000). The declines in these areas vary between individuals (Charness, 2008), and do not occur in a linear manner (Huppert, 2003). It is also important to note that not all capabilities decline with age. Many capabilities continue to develop, such as general knowledge and emotional control (Huppert, 2003). Some of the issues that older adults may experience with technology as a result of the ageing process include difficulties with information organization, system navigation, text and symbol comprehension, fine motor control difficulties, difficulties remembering instructions, difficulties with glare, reduction in execution speed, higher interruption from errors, and increased likelihood of distraction (Fisk et al., 2009).

Utilising intuitive interaction is considered one way to overcome some of the problems older adults experience when using contemporary products. Blackler (2008) identified that older adults use products less intuitively than younger adults.

INTUITIVE INTERACTION

Intuitiveness is one of the most desirable attributes a product can have (Turner, 2008). Some of the characteristics of intuitive interaction include an increase in speed, higher levels of efficiency than other cognitive process, and a lack of conscious awareness as to what is taking place (Blackler, 2008). Intuitive interaction "involves utilising knowledge gained through other experience(s) (e.g. use of another product or something else)" (Blackler, 2008, p. 107).

Other authors conducting research in similar areas have also identified that prior knowledge plays a role in successful product interactions (Hurtienne, 2009; Kang & Yoon, 2008; Langdon, Lewis, & Clarkson, 2009; Lawry, Popovic, & Blackler, 2010; O'Brien, 2010; Reddy, Blackler, Mahar, & Popovic, 2010). Blackler (2008) conducted a thorough review of the literature on intuition and intuitive interaction. She found that, although definitions of intuition varied, most researchers agree that existing knowledge is the foundation of intuitive interaction. Empirical studies have shown this to be true (Blackler, 2008). Blackler (2008) recommends the use of familiar features to improve the intuitiveness of products. Blackler (2008) also identified that older adults use products less intuitively than younger adults.

More recent research has shown that while familiarity with similar technologies contributes to intuitive interaction, technology familiarity does not explain all the performance differences between younger and older adults when using contemporary products (Blackler, Mahar, & Popovic, 2010; Kang & Yoon, 2008; O'Brien, 2010; Reddy et al., 2010). This suggests that age-related declines in cognitive ability also have an effect on product interactions. Blackler et al. (2010), and Reddy et al. (2010) have demonstrated that declines in central executive function (the control component of working memory) had significant relationships with dependent variables related to intuitive interaction. It is clear that central executive function explains some of the differences in performance between younger and older adults, but there has been little research investigating the role of familiarity in intuitive interaction with older adults.

FAMILIARITY

Familiarity is a term that is not often defined in the literature (e.g. Bewley, Roberts, Schroit, & Verplank, 1987; Gulati & Sytch, 2008). However, a common theme running through the discussions of familiarity, and the application of the idea of familiarity to empirical work, is that familiarity is based on prior knowledge. For example, Lim et al. (1996) classified tasks as familiar if actions required to complete a task match the typical person's experience with the real world.

Gefen (2000) is one of the few authors that has defined familiarity. He defined familiarity as "an understanding often based on previous interactions, experiences and learning…" (Gefen, 2000, p. 727). Gulati and Sytch (2008, p. 167) have a similar position, stating that “prior interaction creates ‘familiarity’”.

It is clear that familiarity and intuitive interaction are both grounded in prior knowledge. Raskin (1994) goes as far as to say that, in the context of product interactions, intuitive is a synonym for familiar. Thus, familiarity is a logical place to begin an investigation into why older adults use products less intuitively than younger adults. Results from an earlier study of differences in familiarity between younger and older adults revealed clear differences in familiarity between the youngest age group (18 – 44) and the two oldest age groups (60 – 74, and 75+), when using products they owned that they deemed as familiar (Lawry et al., 2010).

In the initial study, participants used products they owned, and deemed as familiar. There was a negative relationship between age and familiarity. The youngest age group (18 – 44) demonstrated the highest levels of familiarity. Middle Aged adults (45 – 59) demonstrate lower levels of familiarity, but levels that were still high, when compare to the two older age groups. The two oldest age groups (60 – 74 and 75+) demonstrate the negative relationship, but the differences in familiarity between them were much smaller than between any other groups. The results show, that even with familiar products, younger adults higher levels of familiarity than older adults, and that adults above the age of 60 do not differ considerably from one another.

THE GENERATIONAL EFFECT

Docampo Rama (2001) and her colleagues (Docampo Rama, de Ridder, & Bouma, 2001) conducted research into technology generations. The formative years are considered to be the period up until the age of 25. Most major behaviours, values and attitudes are formed during this period (Docampo Rama, 2001). Docampo Rama (2001) has demonstrated that growing up with a particular style of technology has a great effect on the ability to interact with newer interaction styles. She refers to this as a generational effect.

Two patterns in data from studies comparing older and younger adults have been identified, the generational effect and the age effect. Docampo Rama et al. (2001) describe the generational effect as a discontinuous, non-linear effect, while the effect of age is continuous, or linear. Docampo Rama et al.’s (2001) results show that younger adults made significantly less errors than three older age groups. The three older groups also showed no significant differences between each other. The generational differences decreased with practice, while the age related effects persisted (Docampo Rama, 2001).

A generational effect between two groups is likely to be the result of each group being exposed to a different interaction paradigm for the first 25 years of life (Docampo Rama et al., 2001). This suggests that the generational effect is a product of differences in prior knowledge. Docampo Rama et al. (2001, p. 28) take this position, stating that “generation-specific technology experience could also induce differences in using current consumer products.”

EXPERIMENT

The purpose of this experiment was to build on the results of an earlier study (Lawry et al., 2010), to develop a more thorough understanding of familiarity in younger and older adults. The results of the previous study demonstrated differences in familiarity between younger and older adults with familiar products the participants owned (Lawry et al., 2010). This study aims to investigate differences in familiarity between younger and older adults using products that the participants did not own and therefore were likely to be less familiar with.

PARTICIPANTS

A total of 32 participants over four age groups were involved in this study. The age groups were 18 – 44, 45 – 59, 60 – 74, and 75+. Participants were controlled for gender and education level.

APPARATUS AND MEASURES

Participants used four products in this experiment; a 35mm camera, an analogue alarm clock, a digital camera and a digital alarm clock (Figure 1). These products were chosen as they cover a wide range or interaction styles. The experiment was conducted in a laboratory setting, and in two senior citizens centers. The environments in the senior citizens were controlled as much as possible.

Figure 1. Products used in the experiment.

The experiment was recorded using two digital video cameras, one facing the participant, and one aimed over the participant's right shoulder, focusing on the product. The researcher, to ensure adequate detail was captured during the observation, controlled the latter.

A framework of familiarity was developed to evaluate participant familiarity. There are three levels to the framework; not familiar, familiar and very familiar. The framework is based on the skill acquisition framework developed by Anderson (1995) from Fitts (1964, in Anderson, 1995), and the three levels of familiarity correspond to the cognitive, associative and autonomous stages of the skill acquisition model respectively. The cognitive stage sees the individual learning the basics of how to perform a task. The associative stage sees the execution of the task become more fluid, and fewer errors occur. The autonomous stage sees the task become more proceduralised, with cognitive engagement reducing to the point where the individual may not be able to verbalise what s/he is doing (Anderson, 1995).

PROCEDURE

Participants were instructed to read a task sheet of a specific set of activities relevant to a particular product, and then they were shown the product for three seconds. They were then instructed to explain how they thought they would perform the task outlined on the task sheet (Primed Task Recall). After the participant completed the explanation an observation was conducted. S/he was handed the product and asked to complete the task on the task sheet, while delivering concurrent protocol (Observation). This process was repeated for each of the four products. The product order was counterbalanced to prevent bias.

ANALYSIS

The data obtained from the Primed Task Recall and Observation were coded as Very Familiar, Familiar or Not Familar. Each step of each task was coded with Noldus Observer XT, using the heuristics outlined below. The dependent variables reported in this paper are outlined in Table 1.

Code	**Criteria**
Primed Task Recall	
Recalled Very Familiar	Participant is familiar with the specific actions related to performing the task.
Recalled Not Familiar	Participant does not demonstrate familiarity with actions related to performing the task.
Observation	
Very Familiar	Participant exhibits high levels of knowledge about the task.
Not Familiar	Participant has very little or no knowledge about what is required to execute this task.

Table 1. Dependent Variables

The Primed Task Recall and Observation were both coded for familiarity. The coding was based on the three level familiarity framework outlined above, but was also informed by a set of heuristics that was created from a review of the literature on expertise. Expertise research shows that acquired knowledge representations mediate expert performance (Ericsson & Towne, 2010). These representations allow individuals to perform faster, more accurately, and more consistently. Chi (2006a) also states that it is assumed that the differences in the performance levels between experts and non experts are the result of the differences in the way they represent domain specific knowledge. Characteristics of experts helped to form an understanding of what very familiar behaviour looks like. Some of these characteristics include increased recognition of patterns, high levels of domain knowledge and faster skill performance (Glaser & Chi, 1988). For an overview of expertise see Ericsson and Towne (2010). The following heuristics were used to help identify high levels of familiarity.

Forward Planning and Anticipation

Participants who are highly familiar with a string of actions will often integrate the following step into the step that they are currently executing. Anticipation has increasingly been acknowledged as an important element of high performance across multiple disciplines (Williams & Ward, 2007). Forward planning and anticipation was seen to occur in instances of high familiarity in this study. This would often manifest as preparatory actions that would make the following step easier and faster.

Relative Speed

The combination of forward planning and anticipation can result in interaction that is faster than a less familiar participant normally exhibits. The cognitive representations allow the participant to anticipate what is going to happen, and plan his/her next move accordingly, increasing speed within the domain (Ericsson & Towne, 2010)

High Levels of Domain Knowledge

Both highly detailed verbalisation, and a lack of verbalisation can be viewed as a sign of high levels of familiarity. First, high levels of verbalisation will be discussed. Chi (2006b) suggest that experts have more meaningfully integrated representations, which is expressed in verbalisation. Experts often verbalise about subtle and more complicated elements in a domain (Chi, 2006b).

Very low to no verbalisation can also suggest very high familiarity. Anderson (1995) states that as skills are improved to a high level in a particular area, the ability to describe what is being done is often lost. Chi (2006a) states that experts can fail to remember superficial features, and often miss smaller details. Often participants would perform tasks with high familiarity and not verbalise at all, even though they had been instructed to do so. Low verbalisation can also demonstrate low levels of familiarity. Novices lack the knowledge to discuss the interactions in great detail (Anderson, 1995; Chi, 2006b).

RESULTS

Each variable was coded as a percentage of the total number of steps coded within the Primed Task Recall or the Observation. The Familiar code was found to have no significant relationships with age for both the Primed Task Recall and the Observation.

An ANOVA revealed significant variation between age groups and the Recalled Very Familiar code, $F(3,29) = 3.825$, $p < .025$ (Figure 2). Levene's test shows a significant difference in variance, $F(3,29) = 6.685$, $p < .01$. A strict alpha level of .025 was adopted following Keppel and Wicken's (2004) recommendation. The Tukey post hoc test revealed a significant difference between the 18 – 44 age group and all three older age groups ($p <.05$ for all age groups). There were no significant relationships between the three older age groups. This suggests that younger adults demonstrate higher levels of familiarity than older adults, and than the older adults do not differ much for one another. This could be because younger adults have learnt the interaction paradigm for these products during their formative years (Docampo Rama, 2001).

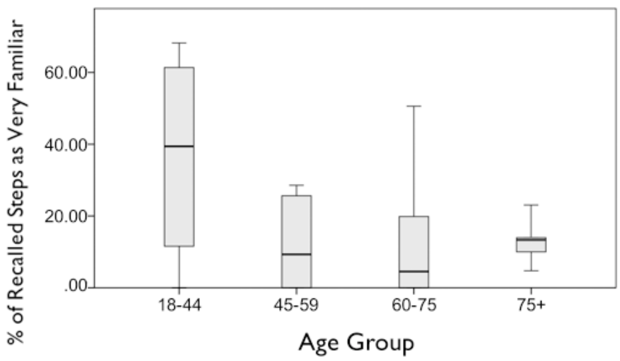

Figure 2. Recalled Very Familiar code, by Age Group.

A one-way ANOVA showed a significant relationship between age group and the Recalled Not Familiar code, $F(3,29) = 4.225$, $p < .05$ (Figure 3). The Tukey post hoc test demonstrated a significant difference between the 18 – 44 age group and the 45 – 59 age group ($p < .05$), and also between the 18 – 44 age group and the 75+ age group ($p < .05$). There was no significant relationship between the 18 – 44 age group and the 45 – 59 age group. Again, there were no significant relationships between the three older age groups. This suggests that older adults describe tasks in less detail than younger adults.

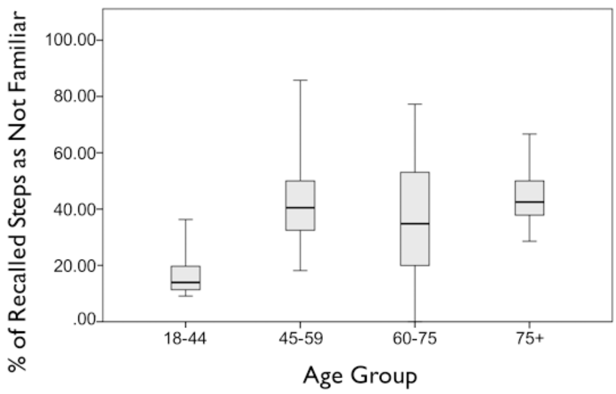

Figure 3. Recalled Not Familiar code, by Age Group.

An ANOVA for the Observed Very Familiar code and Age Group showed a significant relationship, $F(3,29) = 22.496$, $p < .001$ (Figure 4). The Tukey post hoc test demonstrated very significant differences between the 18 – 44 age group and all other age groups ($p < .001$ for all groups). Furthermore, there were no significant differences between the three older age groups. This shows that younger adults are considerably more familiar with contemporary products than older adults. The level of familiarity demonstrated during task execution varied minimally between the other three age groups, suggesting that an age-related effect (Docampo Rama, 2001) is not present for this variable.

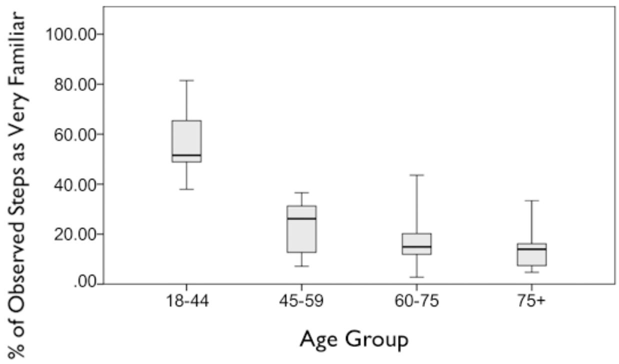

Figure 4. Observed Very Familiar code, by Age Group.

A one-way ANOVA demonstrated a very significant relationship between age group and the Observed Not Familiar code, $F(3,29) = 17.369$, $p < .001$ (Figure 5). The Tukey post hoc test showed very significant differences between the 18 – 44 age group and all three older age groups ($p < .001$ for all groups). As with all other variables, there were no significant differences between the three older age groups. This demonstrates that all three groups of older adults were demonstrating low levels of familiarity much more than younger adults. As above there are similar levels of performance between the three groups of older adults, suggesting that age-related effects do not explain these results.

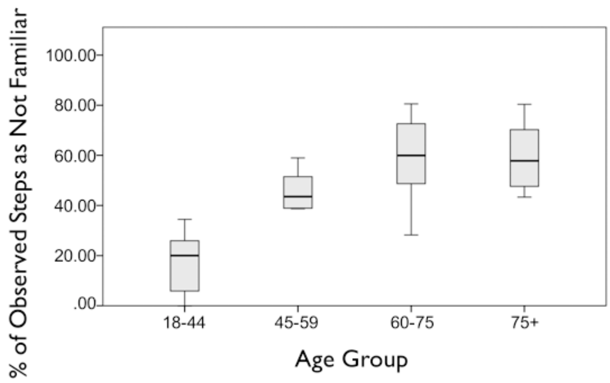

Figure 5. Observed Not Familiar code, by Age Group.

All ANOVAs were significant, even when a strict alpha level of .025 was adopted with a significant result in Levene’s test (Keppel & Wickens, 2004). The results showed no significant relationships between the 45 – 59, 60 – 74 and 75+ age groups across all ANOVAs. There was only one relationship between the 18 – 44 age group and another age group that was not significant. Table 2 illustrates the differences. Significant differences are white, and non-significant relationships are grey.

Method, Code	***p* value**		
	18 – 44 and 45 – 59	18 – 44 and 60 – 74	18 – 44 and 75+
Primed Task Recall, Very Familiar	$p < .05$	$p < .05$	$p < .05$
Primed Task Recall, Not Familiar	$p < .05$	$p > .05$	$p < .05$
Observation, Very Familiar	$p < .01$	$p < .01$	$p < .01$
Observation, Not Familiar	$p < .01$	$p < .01$	$p < .01$

Table 2. p values of relationships between 18 - 44 group and other age groups

DISCUSSION

The findings of this study show that younger adults demonstrate significantly different levels of familiarity from the three older age groups, and that the three older age groups are not significantly different from each other. This replicates findings from the earlier study (Lawry et al., 2010), except the results are even stronger. This is because the products used were not owned by participants, and thus are likely to be less familiar. There is less likelihood that learning will have negated the generational effect (Docampo Rama, 2001). The results clearly show non-linear patterns across all four variables. These findings are very similar to Docampo Rama's (2001). Docampo Rama et al. (2001b) refers to this non-linear pattern as a generational effect. Generational effects manifest as large jumps in performance between age groups, as seen in all variables in this study, and are due to exposure to relevant technology in younger years (< 25 years) (Docampo Rama, 2001). This suggests that the findings from this study are the result of differences in prior knowledge, rather than any age related declines in cognition or other abilities. Also, this study measured familiarity, rather than performance as measured by variable such as time on task, or errors, which are often attributed to age related declines (Kang & Yoon, 2008; O'Brien, 2010).

This has implications for those wishing to design products for older adults. The results clearly show that younger adults are more familiar with contemporary products. While older adults are likely to have more prior knowledge than a younger adult, one reason that they often have difficulties using products is that the knowledge they do have is related to products and systems that have largely been replaced by newer technologies that are interacted with using new methods. For prior knowledge to be useful in an interaction, it should be relevant to either the task or the product.

Other research has demonstrated that central executive function plays a role in intuitive interaction (Blackler et al., 2010; Reddy et al., 2010). While there is research investigating the effectiveness of cognitive training in improving cognitive functions amongst older adults (e.g. Mahncke et al., 2006), the training needs to take place at the user's end, and cannot be influenced by the designer. Also, cognitive training would still not address the generational effect on performance. The integration of familiar features would take place during the design process, and can be controlled by the designer (Blackler, 2008). This research demonstrates that older adults are significantly less familiar with the products used than younger adults. Furthermore, it has identified that this is likely to be the result of older adults having low levels of familiarity with the current interaction paradigm. It would likely be beneficial to discover interaction models that older adults are familiar with, and to integrate this knowledge into future products.

SUMMARY AND FUTURE RESEARCH

This study, and the corresponding earlier experiment (Lawry et al., 2010), are the first known research that directly examines product familiarity. The results show that there are very significant differences between older and younger adults, and that there are not significant differences between the three older age groups. Designers aiming to target older users should attempt to identify what their target audience is familiar with, and integrate this knowledge into the design process. Doing so is likely to reduce performance gaps between younger and older adults.

The future direction of this research is in develop methods to help identify what individuals are familiar with. This knowledge can then be integrated into the design process, which should result in products that are more intuitive to use. The methods developed should be easy to use, highly mobile, cost effective, and robust.

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